



ARC FLASH PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIREMENTS FOR HIGH-VOLTAGE OVERHEAD LINE WORK AT 69 KV (NOMINAL) OR LESS

ENGINEERING TECHNICAL LETTER

DR. DARYL I. HAMMOND
HQ AFCESA/CESM, TYNDALL AFB, FL

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AIR FORCE CIVIL ENGINEER SUPPORT AGENCY
139 BARNES DR, SUITE 1
TYNDALL AIR FORCE BASE, FLORIDA 32403-5319

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FOR THE DIRECTOR:

//SIGNED//

Dr. Daryl I. Hammond, P.E.
Acting Chief of Mechanical Division

//SIGNED//

Brent E. Hill, Colonel, USAF
Director of Engineering Support

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

15 AUG 2006

FROM: HQ AFCESA/CESM
139 Barnes Drive Suite 1
Tyndall AFB FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 06-9: Arc Flash Personal Protective Equipment (PPE) Requirements for High-Voltage Overhead Line Work at 69 kV (Nominal) or Less**

1. Purpose. This ETL provides minimum arc flash PPE for electricians working on overhead high-voltage (HV) lines 69 kilovolts (kV) (nominal) or less. Proper arc flash PPE is required in conjunction with other high-voltage PPE while de-energizing a circuit, re-energizing after work is complete, and in those rare occasions when the authority in Air Force Instruction (AFI) 32-1064, *Electrical Safe Practices*, authorizes work on energized electrical equipment or lines.

Note: This ETL is not applicable to HV underground systems. For those systems, follow NFPA 70E, *Standard for Electrical Safety in the Workplace*, and AFI 32-1064 for appropriate arc flash PPE.

This ETL supersedes ETL 06-1, *Arc Flash Personal Protective Equipment (PPE) Requirements for High-Voltage Overhead Line Work at 69 kV (Nominal) or Less*.

2. Summary of Revisions: Applicability statement added (paragraph 1); supersedure statement added (paragraph 1); summary of revisions added (paragraph 2); emphasizes conducting hazard analysis for selecting PPE (paragraph 6 note); specifies arc rating for face shield and sock hood (paragraphs 6.2.1, 6.3.2, 6.4.1); specifies shoe/boot type (paragraphs 6.2.1, 6.3.1, 6.4.1).

3. Application. Requirements in this ETL are mandatory.

3.1. Authority: AFI 32-1064, *Electrical Safe Practices*.

3.2. Effective Date: Immediately.

3.3. Intended Users:

- Major command (MAJCOM) engineers
- Base civil engineers (BCE)
- Base maintenance organizations

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3.4. Coordination:

- MAJCOM electrical engineers
- Air Force Safety Center (AFSC)

4. Referenced Publications.

4.1. Air Force:

- AFI 32-1064, *Electrical Safe Practices*, available at <http://www.e-publishing.af.mil>
- AFI 90-901, *Operational Risk Management*, available at <http://www.e-publishing.af.mil>
- Air Force Pamphlet (AFPAM) 90-902, *Operational Risk Management (ORM) Guidelines And Tools*, available at <http://www.e-publishing.af.mil>
- ETL 04-15, *Electrical Safety Guidance*, available at: <http://www.afcesa.af.mil/library/etl.asp?Category=Engineering%20Technical%20Letters>

4.2. Joint: Unified Facilities Criteria (UFC) 3-560-02, *Electrical Safety* (Draft), available at: http://www.afcesa.af.mil/ces/cesm/cesm_electrical.asp

4.3. Government: Occupational Safety and Health Administration (OSHA) for General Industry (29 CFR PART 1910): Subpart I, *Personnel Protective Equipment*; Subpart R, 1910.269, *Electrical Power Generation, Transmission and Distribution*; Subpart S, *Electrical*, available at: http://www.osha.gov/pls/oshaweb/owastand.display_standard_group?p_toc_level=1&p_part_number=1910

4.4. Industry:

- National Fire Protection Agency (NFPA) 70E-2004 (or latest version), *Electrical Safety in the Workplace*
- American National Standards Institute (ANSI) C2-2000 (or latest version), *National Electrical Safety Code*
- The Lineman's and Cableman's Handbook, 10th Edition (or latest version)

5. Background.

5.1. Arc flash PPE requirements must be defined for electricians working on or near overhead HV electrical lines operating at 69 kV (nominal) or less. Draft UFC 3-560-02, *Electrical Safety*, Table 8-1, lists the minimum working distances from exposed energized parts that a qualified worker may not approach or place any conductive object without an approved insulating handle unless certain other live-line work techniques are used (such as isolation, insulation, or guarding) in accordance with accepted industry practice. High voltage is defined as any voltage over 600 volts.

5.2. This ETL is intended to provide minimum arc flash PPE that must be worn in conjunction with other high-voltage PPE needed for shock protection when working on HV overhead electrical lines at 69 kV (nominal) or below.

NOTE: This ETL is not intended to provide step-by-step procedures for performing HV work on distribution or transmission lines or to provide an all-inclusive PPE list. Additional PPE or special tools and/or equipment may be required by local procedures, Air Force Occupational Safety and Health (AFOSH) guidance, OSHA guidance, working voltage level, or the task to be performed.

WARNING

Working on energized electrical equipment is prohibited except in rare circumstances, and then only when justified and approved by the BCE or equivalent in accordance with AFI 32-1064

6. Requirements. During the process of de-energizing circuits, re-energizing circuits, or while working on energized equipment (when approved in accordance with the above warning), the minimum arc flash PPE noted in the following paragraphs shall be worn.

NOTE: A documented flash hazard analysis in accordance with NFPA 70E, Article 130.3, can be a basis to modify the arc flash PPE requirements contained in paragraphs 6.2, 6.3, and 6.4 and their associated subparagraphs. Documentation shall include posting the energized work permit and correct PPE at the jobsite. Conducting a hazard analysis is the highly preferred approach for selecting PPE.

NOTE: The hot stick working distance specified in paragraphs 6.1, 6.2, 6.3, and 6.4 is the distance between an exposed fixed circuit part and the closest part of the worker.

6.1. Overhead line work and other exterior pole-line work at hot stick distance less than 10 feet (HV electrical lines above 35 kV [nominal] and at or below 69 kV [nominal]): Working on or near energized circuits or components on HV electrical lines above 35 kV (nominal) and less than 69 kV (nominal) at hot stick distance less than 10 feet is prohibited in all circumstances.

6.2. Overhead line work and other exterior pole-line work at hot stick distance greater than 10 feet (HV electrical lines above 35 kV [nominal] and at or below 69 kV [nominal]). Work includes:

- Outdoor gang-operated switch operation.
- Outdoor disconnect switch operation.
- Outdoor phasing tests.
- Outdoor voltage tests.
- Installing temporary protective grounds on overhead lines.
- Certain maintenance or repair action approved by the BCE in accordance with AFI 32-1064 and documented in the energized work permit; however, before approving energized line work, the BCE must also approve an operational risk management (ORM) assessment prepared by the operations

flight chief. Follow guidance in AFI 90-901, *Operational Risk Management*, and AFPAM 90-902, *Operational Risk Management (ORM) Guidelines and Tools*.

WARNING

Temporarily disable automatic reclosure operation before commencing work outlined in paragraph 6.2 on HV electrical lines above 35 kV (nominal) and at or below 69 kV (nominal).

6.2.1. Clothing to meet arc flash requirements—Hazard Risk/Category 3 (25 cal/cm²) [Recommend 25 cal/cm² coverall for ease of movement], PLUS:

- Hardhat with flame-resistant hard hat liner.
- Flame-resistant single layer sock hood (**NOT** switching or blast hood). Minimum 12 cal/cm².
- Leather or flame-resistant gloves. Where insulating rubber gloves are used for shock protection, leather protectors must be worn over the rubber gloves.
- Leather electrical hazard (EH) rated work shoes/boots.
- Arc flash rated face shield properly attached to a hard hat designed to accept a face shield. Minimum arc rating for the face shield shall be 12 cal/cm².

6.2.2. Other PPE for arc flash protection: Arc flash rated safety harness (as required by AFOSH, OSHA or local requirements).

6.3. Overhead line work and other exterior pole-line work at hot stick distance greater than 8 feet (overhead line voltage at 35 kV [nominal] or below). Typical work includes:

- Gang-operated switch operation.
- Outdoor disconnect switch operation.
- Opening or closing fused cutouts.
- Phasing tests.
- Voltage tests.
- Current tests (with hook sensing head ammeter).
- Installing temporary protective grounds.
- Certain maintenance or repair action approved by the BCE in accordance with AFI 32-1064 and documented in the energized work permit.

6.3.1. Clothing to meet arc flash requirements—Hazard Risk/Category 2 (8 cal/cm²), PLUS:

- Flame-resistant single layer sock hood (**NOT** switching or blast hood) Minimum 8 cal/cm²)
- Voltage-rated rubber gloves with leather protectors.
- Leather electrical hazard (EH) rated work shoes/boots.

6.3.2. Other PPE for arc flash protection (minimum):

- Hard hat
- Safety glasses (no metal frames) with side shields.
- Arc flash rated face shield properly attached to a hard hat designed to accept a face shield. Minimum arc rating for the face shield shall be 8 cal/cm².
- Arc flash rated safety harness (as required by AFOSH, OSHA or local requirements).

6.4. Overhead line work and other exterior pole-line work at hot stick distance less than 8 feet (overhead line voltage at 35 kV [nominal] or below). Typical work includes:

- Certain energized line work approved by the BCE in accordance with AFI 32-1064.
- Placing insulating sleeves or blankets on adjacent conductors in preparation for making an electrically safe work environment.

6.4.1. Clothing to meet arc flash requirements—Hazard Risk/Category 2 (8 cal/cm²), PLUS:

- Flame-resistant coveralls (minimum 8 cal/cm²) over flame-resistant shirt and flame-resistant pants required by Hazard Risk/Category 2.
- Flame-resistant single layer sock hood (**NOT** switching or blast hood) Minimum 8 cal/cm²).
- Voltage rated rubber gloves with leather protectors.
- Leather electrical hazard (EH) rated work shoes/boots.
- Arc flash rated face shield properly attached to a hard hat designed to accept a face shield. Minimum arc rating for the face shield shall be 8 cal/cm².

6.4.2. Other PPE for arc flash protection (minimum):

- Hard hat
- Safety glasses (no metal frames) with side shields.
- Arc flash rated safety harness (as required by AFOSH, OSHA or local requirements).

6.5. Other Tools. Any tools (e.g., hot sticks, insulating rubber sleeves) used as part of the task must be rated and tested/certified for the line-to-line voltage of the

energized equipment. Exception: Rubber gloves used for hot-stick work at 69 kV (nominal) transmission line voltage shall be Class IV.

7. Point of Contact. Recommendations for improvements to this ETL are encouraged and should be furnished to the Electrical Engineer, HQ AFCESA/CESM, 139 Barnes Drive, Suite 1, Tyndall AFB, FL 32408-5319, DSN 523-6352, commercial (850) 283-6352, e-mail AFCESAReachbackCenter@tyndall.af.mil

PATRICK G. MUMME, P.E.
Acting Director of Engineering Support

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